Pesticides

Introduction

Pesticides are unique among environmental chemicals in that they are deliberately released to achieve a specific purpose. They are not an unwanted by-product of another process (such as an industrial operation); rather, they are produced specifically for their toxicity to a target pest. The regulation of pesticides does not focus solely on assessing toxicity, but also on managing risk by controlling exposure. The effects — beneficial, harmful or benign — of pesticides are dependent on several factors, the most important of which is exposure.

The Department of Pesticide Regulation (DPR) evaluates data on a pesticide to determine if it can be used safely in California. Controls imposed upon the use of a pesticide are designed to protect against adverse impacts on human health and the environment. If these controls are found to be ineffective, they may be modified, or if further modifications are not possible, the pesticide is banned from use.

The first pesticide-related law was passed in California in 1901, and today pesticide regulators have a comprehensive, science-based body of law and regulation to control every aspect of pesticide sales and use, to assess the impacts of that use, and to ensure protection of people and the environment. California has approximately 11,000 registered pesticide products. In 1990, California became the first state in the country to require full reporting of all agricultural pesticide use, expanding a system of limited reporting begun a half-century before. The state's program for reporting, investigating, and evaluating pesticide-related illnesses — designed to improve protection of workers and the public — was praised by the General Accounting Office in 1993 as a model for other states to follow.

Pesticide Indicators

Air

Number of detections of pesticides identified as toxic air contaminants and the percent that exceeds numerical health standards each year (Type III)

Water

Area with pesticides detected in well water (Type I)

Simazine and breakdown products in a monitoring network of 70 wells in Fresno and Tulare Counties (Type I)

Pesticide detections in surface water and the percent that exceeds water quality standards (Type III)

Pesticides in food

Percent of produce with illegal pesticide residues (Type I)

Pesticide use

Pesticide use volumes and acres treated, by toxicological and environmental impact categories (Type II)

Integrated pest management

Number of growers adopting reduced-risk pest management systems and the percent reduction in use of high risk-pesticides (based on Alliance grant targets) (Type II)

Human health

Number of reported occupational illnesses and injuries associated with pesticide exposure (Type I)

Ecological health

Number of reported fish and bird kills due to pesticide exposure each year (Type II)

PESTICIDES

Indicator

Number of detections of pesticides identified as toxic air contaminants and the percent that exceeds numerical health standards each year (Type III)

Issue 1: Air

Because pesticide use involves deliberately releasing chemicals to the environment to achieve a specific purpose, pesticides may adversely impact air quality. In California, the Toxic Air Contaminant (TAC) program created by Assembly Bill 1807 provides a statutory framework for the evaluation and control of air pollutants that may cause or contribute to increases in serious illness or death, or that may pose a present or potential hazard to human health. The Air Resources Board is the lead agency for the TAC Program, except for air contaminants that are registered and used as pesticides. The latter are regulated by the Department of Pesticide Regulation (DPR). A total of 37 pesticides have been designated as TACs. There are 200 pesticides identified as candidates for evaluation as TACs.

Indicators

Area with pesticides detected in well water (Type I)

Simazine and breakdown products in a monitoring network of 70 wells in Fresno and Tulare Counties (Type I)

Pesticide detections in surface water and the percent that exceeds water quality standards (Type III)

Issue 2: Water

Pesticides may impact water quality, affecting the suitability of the water for human consumption, for aquatic life, and other uses. Water contamination occurs following runoff of pesticides from treated fields or leaching into groundwater. Historically, investigations into pesticide contamination of water bodies have focused on agricultural activities. A number of regulatory efforts have focused on reducing agricultural sources of contaminants.

There is growing evidence that urban pesticide use is also a source of aquatic pollutants. Although urban pesticide applications are individually small, they involve a wide variety of chemicals and a relatively large number of small applications. Therefore, cumulative impacts may be significant. In some urban creeks, areas of extremely high concentrations ("hot spots") may occur.

Indicator

Percent of produce with illegal pesticide residues (Type I)

Issue 3: Residues in Food

If pesticides are used properly and according to label instructions, there should be no illegal residues on harvested produce. Tolerance levels for pesticide residues on produce are intended to protect against adverse impacts on human health. The presence of illegal residues may indicate improper or illegal pesticide use, as well as problems in the state's integrated network of pesticide regulatory programs. Illegal pesticide use can also adversely impact the health of wildlife and sensitive ecosystems.

Issue 4: Pesticide Use

Pesticides can be applied in a manner that increases the quality and production of agriculture and enhances public sanitation (water, food preparation, etc.). However, these benefits are not without risks to human health and the environment. Because pesticides are designed to be toxic to unwanted organisms, there are many public concerns about the widespread use of pesticides and the potential risks they pose to human and environmental health.

Indicator

Total pounds applied and cumulative acres treated by all pesticides in different toxicological and environmental impact categories in California each year (Type II)

Issue 5: Integrated Pest Management

Integrated pest management (IPM) is a long-term approach to managing pests combining biological, cultural, and chemical techniques in a program that is scientifically-based, economically sound, and beneficial to the environment. Pest management techniques may be utilized in a manner that benefits consumers, workers, the environment, and agriculture, without heavy reliance on pesticides. IPM is based on extensive monitoring to assess the levels of pests, and of natural enemies. Pest management decisions are made based on monitoring results, utilizing the most appropriate technique. Examples of IPM techniques include cover crops, crop rotation, crop sanitation to remove overwintering pests, release of natural enemies, pheromone confusion, use of products that act as insect growth regulators, and the selective, targeted use of chemical pesticides. Such pest management techniques avoid the hazards created by exposure to highly toxic pesticides.

Indicator

Number of growers adopting a reduced-risk pesticide pest management system and the percent reduction in use of high-risk pesticides (based on Alliance grant targets) (Type II)

Issue 6: Human Health

Pesticides have been associated with adverse effects on human health. Given the nature of their contact with pesticides, agricultural and pest control workers are most likely to face exposure to pesticides. The public may be exposed to pesticides in water, soil and air due to misuse or drift from sprayed areas. Consumers may face exposure from home-use pesticides, or to pesticide residues in food. Unacceptable risks may be avoided when pesticides are used properly, and when pesticide laws and regulations are enforced vigorously and consistently.

Indicator

Number of reported occupational illnesses and injuries associated with pesticide exposure (Type I)

Issue 7: Ecological Health

Pesticides are designed to be toxic to target pests. While their use instructions are intended to prevent adverse impacts on nontarget species, including wildlife, there have been instances when pesticide use has been linked to adverse impacts on birds, bees, and other nontarget species.

Indicator

Number of reported fish and bird kills due to pesticide exposure each year (Type II)

Type I

Level 4
Goal 3, 4

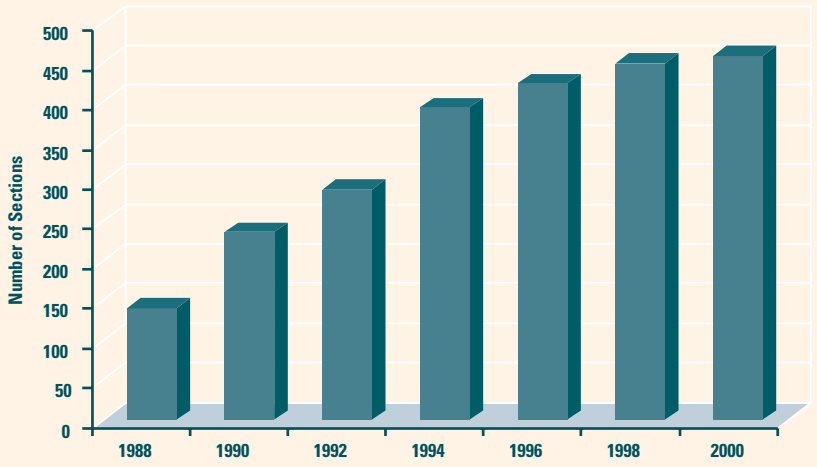
Area with Pesticides Detected in Well Water

In 2000, the cumulative land area where pesticide use is subject to special restrictions to protect groundwater totaled approximately 460 square miles.

What is the indicator showing?

The indicator shows a cumulative measure of land area where the Department of Pesticide Regulation (DPR) regulates pesticide use for groundwater protection. Pesticide use is regulated in these areas because residues have been detected in well water as the result of legal non-point source applications. As of 2000, DPR regulates a total of approximately 460 square-mile sections of land. The addition of new regulated areas is dependent upon the discovery of pesticide residues in wells which, in turn, is related to sampling activity.

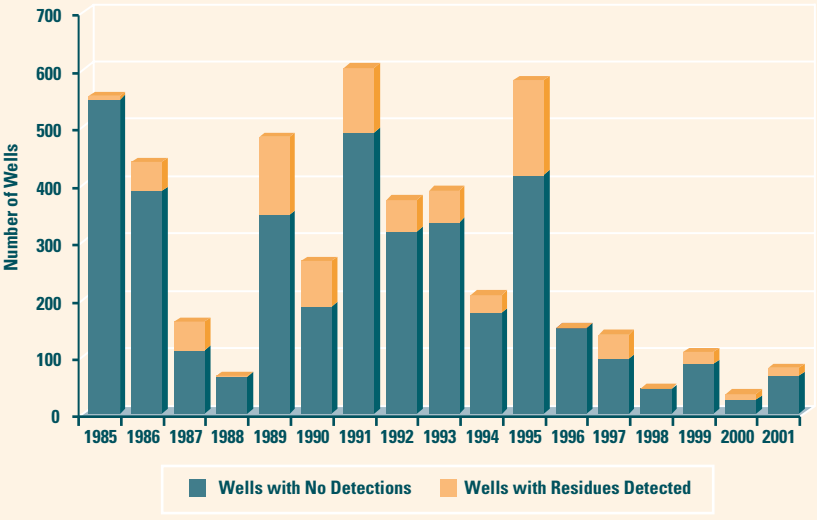
Cumulative Number of Sections* of Land where Pesticide Use is Regulated by DPR for Groundwater Protection



** A section is a one-square mile area based on the U.S. Geological Survey Public Land Survey coordinate system*

The companion graph shows the number of wells sampled yearly by DPR, and the number in which pesticides were detected. Sampling activity during the last five years has been much lower than the previous five years. In some years, nearly one-third of the wells sampled have contained pesticide residues.

Number of Rural Wells Sampled Yearly by DPR and Number of Wells with Detection of Pesticide Residues



Why is the indicator important?

The indicator presents the cumulative land area in California where pesticide use is subject to special restrictions to protect groundwater. One approach taken by DPR is to regulate pesticide use in sections of land where pesticide residues have been detected in well water, and where their presence was determined to result from legal, non-point source applications. These sections of land are regulated as "pesticide management zones" and reflect areas that are vulnerable to groundwater contamination by pesticides. A section of land is a one-square mile area based on the U.S. Geological Survey (USGS) Public Land Survey coordinate system.

DPR monitors the presence of pesticide residues in California's groundwater by obtaining samples of well water. Many wells are located in rural, agricultural settings. These areas are not routinely monitored by the Department of Health Services for compliance with drinking water standards, i.e., maximum contaminant levels (MCLs). Pesticide residues are periodically detected in new areas of the state. Well sampling data are used to identify those pesticides that pose a risk of groundwater contamination following application, and to delineate areas in the state where residues can move to groundwater. Based on this information, regulatory safeguards are formulated by DPR to protect against further groundwater contamination.

Since 1984, 16 pesticides and breakdown products have been detected in groundwater as the result of legal, agricultural use: 1,2-dichloropropane (1,2-D), 2-amino-4-chloro-6-ethylamino-s-triazine (ACET), aldicarb, aldicarb sulfone, aldicarb sulfoxide, atrazine, bentazon, bromacil, dibromochloropropane (DBCP), deethyl-atrazine, diuron, ethylene dibromide (EDB), norflurazon, prometon, simazine, and 2,3,5,6-tetrachloroterephthalic acid. DBCP, 1,2,-D, and EDB are no longer registered for use.

What factors influence this indicator?

Resources available to DPR for this activity limit the number of wells sampled annually. The graph depicts a decrease in the rate at which new sections of land have been added in recent years. The decrease in the number of new sections is related to a decrease in the number of wells sampled annually by DPR, rather than to a full accounting of the spatial extent of contamination in California. For example, in 1997 and 1998 a total of 182 wells were sampled, compared to 713 wells in the previous two years.

The Pesticide Contamination Prevention Act of 1985 (the Act) directed DPR to sample wells for pesticides that have a high potential to move to groundwater. The program obtains water samples primarily from rural domestic wells, which typically serve one household. These wells have a higher chance for detection of pesticide residues because they are usually shallower in depth than municipal wells and they are located within areas of intense pesticide use. The sampling program is voluntary, that is, well owners are solicited for their participation.

While this could be viewed as a limitation, the program has experienced a very high rate of cooperation so that this has not been a limiting factor.

Technical Considerations:

Data Characteristics

The well sampling program conducted by DPR targets specific pesticides that have a high potential for detection in groundwater, and the sampling is conducted in areas of the state where these pesticides are used. Data for determination of pesticide residues in well water samples are obtained by other state, local, and federal entities. State agencies must report well sampling for pesticide residues to DPR. This information is stored in the Well Inventory Database, which is maintained by DPR as mandated by law. The database contains 933,969 records for 21,187 unique wells. This information is also used to determine new sections where pesticide residues have been found. DPR responds to positive detections by analyzing the chemical analytical data, conducting site inspections, and re-sampling wells when appropriate.

Detections of new active ingredients in California's groundwater are subject to a decision-making process mandated by the Act. Regulatory decisions have ranged from suspension of use if no mitigation measures are available, to continued use of pesticides in sections when mitigation measures have been identified. The area of land where pesticide use is subject to special restrictions reflects only those sections where use is allowed according to the appropriate mitigation measure. Thus, the spatial extent of known groundwater contamination, as well as the impact of regulations, are underestimated. The data do not capture those land areas where groundwater contamination is known to have occurred where the regulatory action was to suspend use. For example, a study conducted in 1989 for the presence of bentazon in well water produced detections in 59 sections. Based on these detections, the regulatory decision was to suspend use on rice. These sections are not formally included in the count of sections where pesticides are regulated because the decision impacted all rice acreage.

Strengths and Limitations of the Data

The number of domestic wells sampled and the spatial coverage has varied annually in relation to budgetary constraints. The number of detections is also influenced by the detection limit of the analytical methods as well as pesticide use. For example, detection limits for many pesticides can be lower given today's analytical methods versus higher detection limits for analytical methods 10 to 20 years ago. Detections of specific pesticides may increase as pesticide use increases in a given geographic location.

As discussed earlier, the land area tracked by the indicator corresponds to those in which pesticide applications are regulated by DPR. Areas in which groundwater contamination had occurred, but where the regulatory response was to suspend the use of the pesticide, are not captured by this indicator.

Reference:

Guo, F., D. Bartkowiak, D. Weaver, J. Troiano, M. Pepple, F. Spurlock, and C. Nordmark. *Sampling for Pesticide Residues in California Well Water: 2000 Update of the Well Inventory Database*. EH 00-15, Environmental Monitoring and Assessment Branch, Department of Pesticide Regulation. Posted at: www.cdpr.ca.gov/docs/empm/pubs/ehapreps/eh0015.pdf

For more information, contact:

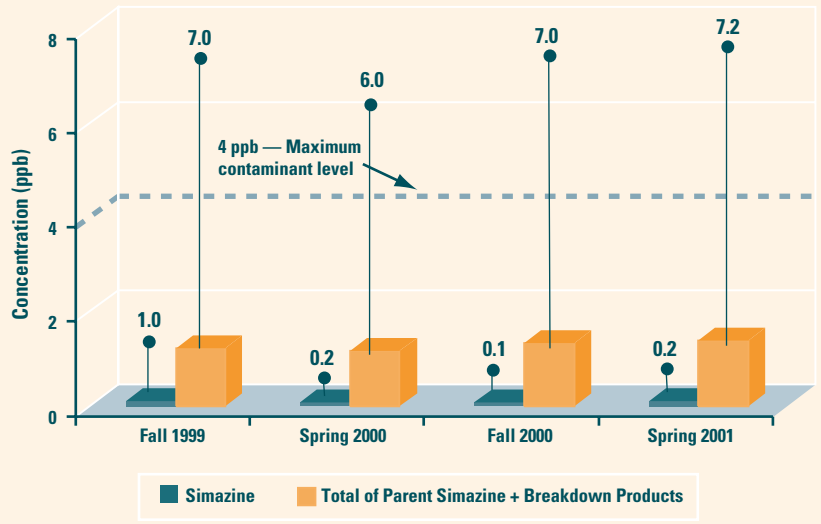
John Troiano
Department of Pesticide Regulation
Environmental Monitoring Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4115
jtroiano@cdpr.ca.gov

Simazine and Breakdown Products in a Monitoring Network of 70 Wells in Fresno and Tulare Counties

Concentrations are relatively stable over the past sampling periods.

Type I

Level 4
Goal 3, 4



What is the indicator showing?

Among 70 wells monitored in Fresno and Tulare Counties since 1999, detections of simazine have not exceeded the maximum contaminant level (4 parts per billion [ppb]), marked as the dashed line on the graph). Simazine breakdown products in the same water samples were found at higher concentrations; when all triazine residues are added together, their sum can exceed 4 ppb, as indicated by the plot of the maximum values measured.

Why is this indicator important?

The indicator presents data obtained from monitoring conducted by the Department of Pesticide Regulation (DPR) for the presence of simazine and its breakdown products in a network of wells in Fresno and Tulare Counties. Previous sampling studies have identified portions of these counties as vulnerable to groundwater contamination by pesticides. The indicator tracks a network of approximately 70 rural domestic wells that are a source of drinking water for primarily single-family residences, and that had previously been shown to contain pesticide residues. The wells are sampled in the spring and in the fall, starting in the fall of 1999. The concentrations measured are compared to a water quality standard. The indicator provides a direct measure of the potential exposure to simazine and its breakdown products in drinking water.

Simazine is a pre-emergence herbicide used to control annual grasses and broadleaf weeds in citrus orchards. It is widely used in the area of the monitoring well network. Residues have been detected in nearly all of the monitoring wells. The current California and national drinking water standard or "maximum contaminant level" (MCL) for simazine is four micrograms per liter, or four parts per billion (4 ppb). This standard was derived from the level determined to protect the most sensitive long-term adverse health effect (decreased body weight) as determined from a two-year cancer study in rats.

Results are also presented for simazine's breakdown products which, because of their structural similarity to simazine, are expected to exhibit similar toxicity; however, health standards have not yet been developed for the breakdown products.

Levels of simazine have not excceded the MCL. However, when concentrations of simazine and its breakdown products are added together, the sum exceeded the drinking water standard in approximately 10 percent of the wells each year. The maximum values are shown on the graph.

The data will be used to measure the success of DPR's regulatory program that is designed to prevent groundwater contamination through improved management practices. The regulations have not yet been enacted, so these data provide background information from which to determine the effectiveness of the regulatory changes. (An explanation of the changes being considered can be obtained from: www.cdpr.ca.gov/docs/empm/gwp_prog/gwp_prog.htm)

What factors influence this indicator?

Pesticide residues move to groundwater through a combination of geographic and management factors. The area in which these wells are located is intrinsically vulnerable to groundwater contamination based on predominant soil types and on the shallowness of the groundwater. Since water is necessary for the eventual movement of pesticide residues to wells, percolation and runoff of water produced from irrigation or rainfall events are the predominant ways in which pesticides move from sites of application. Management practices that either avoid contact with percolating or runoff water or that manage the amount of percolating or runoff water will influence the eventual frequency and magnitude of detections.

Technical Considerations:

Data Characteristics

The data are collected from DPR's sampling of a network of 70 wells in Fresno and Tulare Counties. The wells are rural, domestic wells that are sampled with the consent of the well owners. Each water sample is analyzed for ten chemicals, of which three are breakdown products of triazine herbicides. MCLs have been established for three of the parent pesticides. Residues of simazine have not been measured above its MCL.

Simazine has two major breakdown products that are detected in the sampled wells at higher concentrations and at greater frequencies than simazine itself. When the concentrations of parent simazine and its breakdown products are added together, the sum can exceed the 4 ppb MCL. Although the toxicity of the breakdown products is thought to be similar to the parent pesticide, a determination has not yet been made as to the toxicological significance of the total concentrations of simazine and its breakdown products relative to the MCL.

Strengths and Limitations of the Data

The data reflect only the condition of groundwater in the Fresno and Tulare Counties area. Pesticides are detected in other areas of California but resources do not support a comprehensive monitoring system. Under a recent proposal, the area represented by the well network will receive increased regulatory attention. Thus, monitoring the changes in residue concentrations over time will be an important indicator of the success of pollution prevention efforts. A long-term commitment to sampling is necessary because, even in areas of shallow groundwater, changes made at the soil surface will take at least five years (as determined from an age dating study conducted in this area [Spurlock, et al., 2000]) to affect concentrations measured in wells.

Comparison of the concentrations of the contaminants at the wells to the relevant MCL is used by the Department of Health Services to regulate public drinking water, including municipal wells. Domestic wells have not received the same level of monitoring as municipal well systems, and have not been subject to the same level of regulatory activity.

References:

Troiano, J., D. Weaver, J. Marade, F. Spurlock, M. Pepple, C. Nordmark, D. Bartkowiak. 2001. *Summary of Well Water Sampling in California to Detect Pesticide Residues Resulting from Nonpoint-Source Applications*. Journal of Environmental Quality 30:448-459.

Garretson, C. 1999. *Protocol for Monitoring the Concentration of Detected Pesticides in Wells Located in Highly Sensitive Areas*. Posted at: www.cdpr.ca.gov/docs/empm/pubs/protocol.htm

Spurlock, F., K. Burow, and N. Dubrovsky. 2000. *Chlorofluorocarbon Dating of Herbicide-Containing Well Waters in Fresno and Tulare Counties, California*. Journal of Environmental Quality 29:474-483.

For more information, contact:

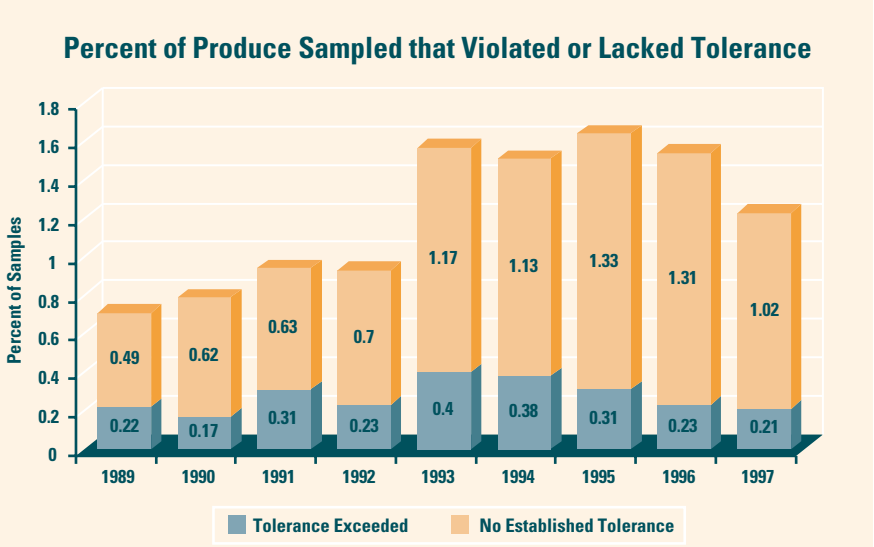
John Troiano
Environmental Monitoring Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4115
jtroiano@cdpr.ca.gov

Type I

Level 4
Goal 4

Percent of Produce with Illegal Pesticide Residues

Illegal residues are detected in less than 2 percent of produce sampled.



What is the indicator showing?

From 1989 through 1997, less than 2 percent of produce samples had illegal pesticide residues. Of these, less than half a percent exceeded allowable levels (tolerances); a higher proportion contained residues for which allowable levels of the pesticide have not been established for the produce in which it was found.

Why is the indicator important?

The indicator shows the percentage of produce samples that contain illegal pesticide residues. Pesticide residues are illegal when they occur above regulatory "tolerance" levels established by U.S. Environmental Protection Agency (U.S. EPA), or when the pesticide is found on a commodity for which it is not registered (in such cases, no tolerance exists). A tolerance is established for a specific pesticide/commodity combination. U.S. EPA has established approximately 9,700 tolerance levels. These levels incorporate a margin of safety, and are intended to protect against adverse health effects. (Residues below a tolerance level are presumed not to pose a health concern.) Occasional consumption above tolerance level does not necessarily result in adverse effects.

This indicator characterizes the safety of produce in California by providing a direct measure of the level of pesticide residue in produce. Monitoring helps ensure that produce offered for sale complies with regulatory standards for pesticides in produce. Tracking pesticide residues is an important tool to enforce regulatory standards designed to prevent potentially harmful exposures to pesticide residues.

There are approximately 942 pesticide active ingredients registered with the U.S. EPA. Produce samples are routinely screened for the 200 most commonly used pesticides and breakdown products. Many samples are also analyzed for pesticides not on the residue screen.

The Department of Pesticide Regulation (DPR) investigates every case of illegal residue. If the produce originated outside of California, the information is forwarded to the U.S. Food and Drug Administration (FDA) for further enforcement action. If the produce was grown in California, DPR attempts to learn how it was contaminated before determining appropriate enforcement action. DPR, working with the county agricultural commissioners, has wide-ranging authority to deal with violators of pesticide laws and regulations.

What factors influence this indicator?

In California, samples of domestic and imported produce are taken throughout the channels of trade: at seaports and other points of entry into the state, packing sites, and wholesale and retail outlets. More than 7,000 samples taken annually are tested for more than 200 pesticides and breakdown products. Although the number of samples has varied over the past decade, the findings have been consistent from year to year: Most residues are below detectable limits. Residues that are found are usually at extremely low levels (a fraction of a part per million). Between 1989 to 1997, illegal residues were found in less than 1 percent of California-grown produce, and approximately 2 percent of foreign-grown produce. Violations commonly involve traces of pesticides not registered for the commodity on which they are found, often as a result of drift from adjacent applications, rather than from direct misuse of a pesticide on a commodity.

The effectiveness of DPR's monitoring program is enhanced by a formal cooperative agreement with the FDA, which has an extensive nationwide produce monitoring program. This cooperative agreement leads to a more comprehensive understanding of the incidence of pesticide residues in the food supply.

Technical Considerations:

Data Characteristics

The data are from the DPR Marketplace Surveillance Program. Samples are collected throughout the state from five different types of sites: wholesale markets, chain store distribution centers, retail outlets, field, and point of entry. Each sample is analyzed with a multi-residue screen capable of detecting more than 200 pesticides and breakdown products. Analysis is typically conducted within eight hours of collection.

Approximately 75 commodities are targeted annually. These commodities are chosen for reasons such as: history of violations; high market volumes; and dietary significance based on consumption frequencies, and/or consumption by infants and children at higher rates than adults.

Strengths and Limitations of the Data

California has the oldest and most comprehensive state monitoring program for fresh produce in the nation. Sampling is weighted toward such factors as patterns of pesticide use; relative number and volume of pesticides typically used on a commodity; relative dietary importance of the commodity; past monitoring results; and knowledge of local pesticide use. Therefore, the results may be biased toward finding produce more likely to contain illegal residues than if samples were collected randomly. In addition, the number of samples of a given commodity analyzed for a particular pesticide each year may not be sufficient to draw specific conclusions about the residue situation for the whole volume of that commodity in commerce.

Reference:

Department of Pesticide Regulation, Pesticide Residue Monitoring Program. Posted at: www.cdpr.ca.gov/docs/dprdocs/residue/resi1997/rsfr1997.htm

For more information, contact:

Terry Schmer
Enforcement Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
tschmer@cdpr.ca.gov
(916) 445-4023

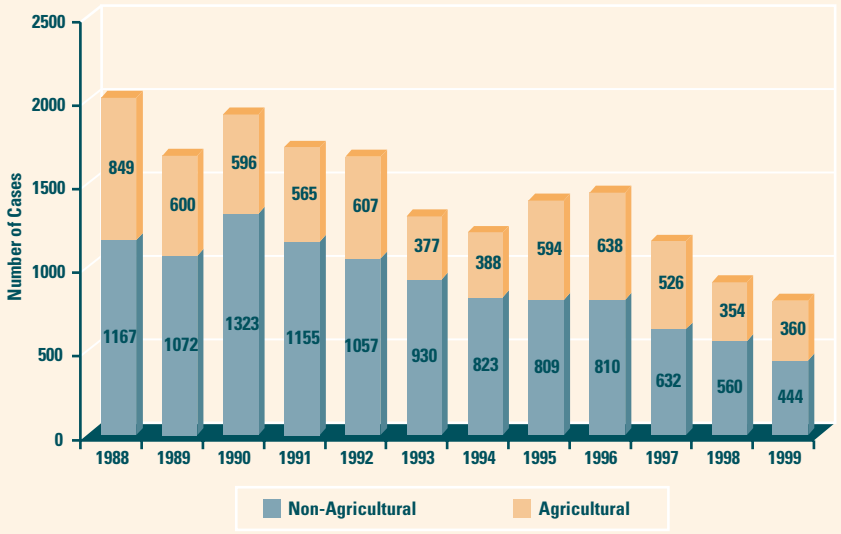
Number of Reported Occupational Illnesses and Injuries Associated with Pesticide Exposure

Pesticide-related illnesses and injuries have declined overall.

Type I

Level 6
Goal 4

Reports Received by the California Pesticide Illness Surveillance Program, and Evaluated as Definitely, Probably or Possibly Related to Occupational Pesticide Exposure

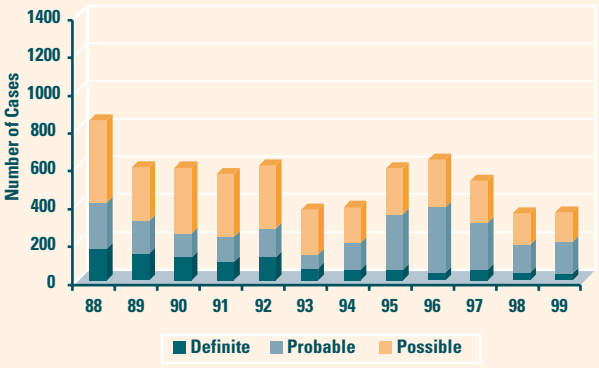


What is the indicator showing?

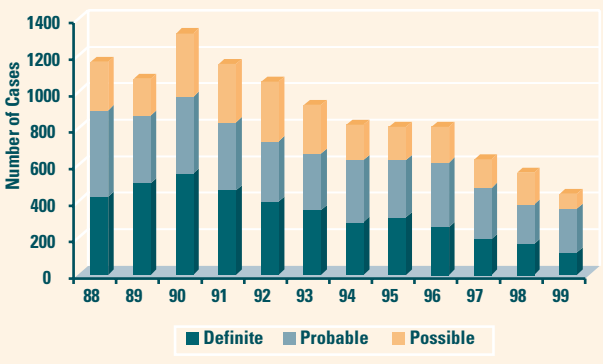
Reported pesticide-related illness and injury have declined over the past 11 years. More of the reported incidents are related to non-agricultural than to agricultural pesticides.

The graphs below show the number of occupational cases evaluated as definitely, probably or possibly related to pesticide exposure, according to the type of pesticide use.

Occupational Illnesses and Injuries Evaluated as Definitely, Probably, or Possibly Related to Exposure to Agricultural Pesticides



Occupational Illnesses and Injuries Evaluated as Definitely, Probably, or Possibly Related to Exposure to Non-Agricultural Pesticides



Why is this indicator important?

This indicator is a direct measure of the immediate impact of pesticides on human health in the workplace. There are two categories of occupational illness cases: agricultural and non-agricultural. Tracking acute illnesses allows the identification and mitigation of situations that lead to excessive exposures, avoiding chronic as well as acute effects.

California's Pesticide Regulatory Program has tracked occupational pesticide-related illnesses and injuries since the early 1970s. (The graphs track cases beginning in 1988, the year when the variables collected and incorporated into the data base were expanded.) The Department of Pesticide Regulation (DPR) and county agricultural commissioners (CACs) seek out, investigate, record, and analyze incidents in which pesticide exposure appears to have harmed human health in the workplace. Trends in illnesses and injuries can be used as an indicator of the effectiveness of the pesticide regulatory program in protecting worker health and safety, in planning compliance and enforcement efforts, selecting exposure studies, and evaluating regulatory requirements. DPR has insufficient data to include non-occupational illness in this indicator. Non-occupational injuries are seldom reported for reasons stated below.

What factors influence this indicator?

Since 1971, California law has required that physicians contact their local health department whenever they suspect an illness or injury is related to pesticide exposure. Since physicians often do not report potential pesticide illnesses, DPR also reviews occupational illness reports submitted to the state workers' compensation system. There has been a distinct downward trend in most categories of workplace pesticide-related illnesses and injuries reported. This may reflect fewer occurrences of illnesses and injuries, fewer physician visits by persons exposed to pesticides, less recognition by physicians that a patient exhibits pesticide-related symptoms, or a decrease in the number of recognized cases reported through the system. Certain barriers prevent some workers from seeking medical care; also, patients may fail to relate pesticide exposure to symptoms they are experiencing. It seems likely, however, that the prevalence of these latter factors has not changed from a decade ago.

DPR constantly works to improve both workplace safety regulations and the ability to recognize the adverse effects of pesticides on human health. Several efforts have been initiated to improve pesticide illness reporting, including pesticide illness recognition training for health care professionals conducted by the Office of Environmental Health Hazard Assessment (OEHHA), and DPR's pesticide training for workers and alliance with the California Poison Control System. These efforts should increase the number of cases reported and investigated.

In some cases, a single incident can involve a large number of workers. Sudden jumps in case numbers generally reflect these types of occurrences, such as the Kern County incident when an application of a pesticide to cotton drifted into a

vineyard where approximately 1,000 harvesters were at work.

Technical Considerations:

Data Characteristics

Physicians are required under state law to contact their local health department whenever they suspect an illness or injury is related to pesticide exposure. The health department notifies the CAC, and completes a pesticide illness report. Copies of this report are sent to OEHHA, the California Department of Industrial Relations, and DPR. Illness reports are also collected from the state workers' compensation system.

The indicator is based on cases where physicians reported any suspected or confirmed pesticide illness or injury in the workplace, and any cases reported under worker compensation claims. The CAC investigates each case to determine why and how the illness or injury occurred. Investigations begin when a report mentions a pesticide as a possible cause of injury. Reports that cite unspecified chemicals also prompt investigation if the incident occurs in a setting associated with pesticide use. DPR scientists use this information to determine the probability that an illness or injury was caused by the pesticide exposure.

Occupational cases involve persons exposed to pesticides at their workplace. This includes persons who mix, load and apply pesticides in agricultural, industrial, institutional and residential workplace settings, field workers who come in contact with pesticide residues on agricultural crops, or any other persons who come in contact with pesticides while on the job. "Agricultural" cases involve pesticides used to produce an agricultural commodity (e.g., crops, livestock), or accidentally released in these settings. "Non-agricultural" cases involve pesticides used or accidentally released in residential, institutional, industrial, and commercial settings.

OEHHA conducts physician training on pesticide illness recognition. Nevertheless, physicians may not always report potential pesticide illnesses.

Strengths and Limitations of the Data

California's surveillance program is the oldest and largest such effort in the United States. It is the only one to attempt to cover all types of pesticides and all occupational exposure scenarios. County agricultural commissioners conducted on-site investigations for over 95 percent of the case reports in the database, and trained scientists evaluate the investigation reports.

Heavy reliance on reports from the workers' compensation system inevitably biases the surveillance program toward occupational exposures. People injured off the job, or who fail to seek medical care after pesticide exposures, are not included. Non-occupational exposures are seldom reported. Reporting aspects of California's surveillance program also tend to emphasize acute rather than chronic illnesses related to pesticide exposures.

Reference:

Department of Pesticide Regulation. California Pesticide Illness Surveillance Program (1988 – 1999). Annual Summaries, posted at: www.cdpr.ca.gov/docs/dprdocs/docsmenu.htm

For more information, contact:

Marylou Verder-Carlos
Worker Health & Safety Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4204
mverder@cdpr.ca.gov

Type II

Pesticide Use Volumes and Cumulative Acres Treated, by Toxicological and Environmental Impact Categories

In order to understand what effect pesticides have on the environment and human health, the first step is to know how much pesticide was actually applied, broken down by categories based on human toxicity and environmental impacts. Total volumes provide a measure of the amount applied in the environment; volume alone, however, can be misleading because different pesticides are applied at widely varying rates. A measure of the cumulative acres treated is not affected by the rate of use. Neither parameter provide a measure of pesticides' effects on the environment or human health.

All production agricultural pesticide use and some other kinds of uses must be reported to the Department of Pesticide Regulation. The information collected for each agricultural application includes what pesticide was applied, how much was applied, and the area treated. This full use reporting system has been operating since 1990 and all data are contained in the pesticide use report (PUR) database. Because the data represent a census of production agricultural use, rather than just a sample, they should be close to actual use. Also, the data are extensively checked for errors.

At present, the PUR data do not include all pesticide use. Home and garden use and most industrial and institutional uses are not covered by the reporting requirement. Regulations require that all pesticide use in production agriculture be reported. The percent of that use relative to the other categories of use is not known.

Reference:

Department of Pesticide Regulation. *Pesticide Use Reports 1990 – 1999*. Posted at: www.cdpr.ca.gov/docs/pur/purmain.htm

For more information, contact:

Larry Wilhoit
Pest Management and Licensing Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4271
lwilhoit@cdpr.ca.gov

Type II

Number of Growers who Adopt Reduced-Risk Pest Management Systems, and the Percent Reduction in Use of High-Risk Pesticides (Based on Alliance Grant targets)

DPR offers financial support through its reduced-risk grants program, consisting of two parts, the Pest Management Grants established in 1996, and Pest Management Alliance Grants, established in 1998. The goal of this program is to reduce the risks from pesticide use to people and the environment by promoting adoption of alternative pest management practices.

The program provides funding to encourage increased implementation of biologically intensive reduced-risk pest management through projects that address key areas of concern. Both Pest Management Grants and Alliance Grants demonstrate alternatives to highly toxic pesticides, protect surface and groundwater quality, and develop alternative reduced-risk approaches for urban pest management. Unlike the Pest Management Grants, which are small regional projects, Alliance Grants address some of the more important pest management issues on a regional or statewide scale. The grants provided

References:

Department of Pesticide Regulation. *Pesticide Use Reports 1990 – 1999*. Posted at: www.cdpr.ca.gov/docs/pur/purmain.htm

Grower surveys; progress and final reports of each grant; formal presentations; field meetings; publications and other outreach events.

under DPR's Pest Management Grants Program are grower-community-and-industry-driven projects providing education through demonstration and outreach.

This indicator will provide a measure of the adoption of reduced-risk management systems. The grants fund local, regional and statewide projects demonstrating reduced-risk alternatives. Measures of success are reported to DPR but data are currently insufficient to accurately measure the rate of adoption.

For more information, contact:
Bob Elliott
Pest Management and Licensing Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4156
belliott@cdpr.ca.gov

Number of Reported Fish or Bird Kills/Year Due to Pesticide Use

Type II

The number of fish and bird kills each year that can be linked to pesticide use provides an indication of the ecological impacts of pesticides. This indicator will provide information that may indicate off-target movement of pesticides, the need for mitigation measures, or the need to re-evaluate a pesticide's toxicity, application methods (including dosage/rate/frequency of application), and cultural practices (a single or a series of farming practices, including irrigation that affect the release, spread, activity or effect of a pesticide). Fish or bird kills may result from secondary poisoning (i.e., when a predator or scavenger eats contaminated prey), and may directly or indirectly affect threatened or endangered species.

Data on fish or bird kills are derived from:

- Priority investigations, typically conducted by county agricultural commissioners within 48 hours of receipt of a notification from DPR or the U.S. Environmental Protection Agency; these investigations, which are addressed by a memorandum of understanding involving the latter agencies and the county agricultural commissioners, are commenced when an incident meets certain triggers – i.e., it involves at least 500 non-target fish, 50 non-target birds, or 1 endangered species;
- Pesticide Episode Investigation Reports (PEIRs) which cover routine investigations by the county agricultural commissioners of fish or bird kills that do not meet the triggers for priority investigations; the PEIRs are submitted to the local DPR regional office;
- Complaints received by the county agricultural commissioners or by DPR from citizens and other agencies;
- Referrals from agencies which, in the course of carrying out their responsibilities, come across information falling under the jurisdiction of the county agricultural commissioner or DPR;

References:
Cooperative Agreement between the State of California, Department of Pesticide Regulation, California Agricultural Commissioners and Sealers Association, and U.S. EPA, Region 9 (Enforcement Letter 2001-020). Posted at www.cdpr.ca.gov/docs/enfcmpli/penfltrs/penf2001/2001020.htm

Memorandum of Understanding between Department of Fish and Game, Department of Pesticide Regulation, and California Agricultural Commissioners and Sealers Association (Enforcement Letter 2000-030). Posted at www.cdpr.ca.gov/docs/enfcmpli/penfltrs/penf2000/2000030.htm

Pesticide/Wildlife Incident Response Plan (PWIRP) and Plan Agreement (Enforcement Letter 2000-030). Posted at www.cdpr.ca.gov/docs/enfcmpli/penfltrs/penf2000/2000030.htm

Priority Investigation Case Log (maintained on calendar year basis)

Pesticide Episode Incident Reports (PEIRs) (maintained in DPR Regional Offices)

(County) Episode Tracking Logs (maintained in DPR Regional Offices)

Complaints (maintained in DPR Regional Offices)

Referrals (maintained in DPR Regional Offices)

References (cont.)
Department of Fish and Game, Pesticide Investigations Unit. Fish and Wildlife Loss Inventory (maintained on calendar year basis)

Laboratory analyses of water, soil, foliage, swab, or tank mix samples for individual bird/fish kill incidents conducted by the California Department of Food and Agriculture, Center for Analytical Chemistry (maintained in the DPR Regional Office representing the county in which the incident occurred).

Laboratory analyses of bird/fish tissue conducted by the Department of Fish & Game (may be available from DPR's Pesticide Registration Branch).

For more information, contact:

Jim Shattuck
Enforcement Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 445-3860
jshattuck@cdpr.ca.gov

Nick Surjan
Enforcement Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 445-3864
nsurjan@cdpr.ca.gov

Louis Watson
Enforcement Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 445-3894
lwatson@cdpr.ca.gov

- Pesticide/Wildlife Incident Response Plan Agreement involving county agricultural commissioners, DPR, and the Department of Fish and Game (DFG), which establishes notification procedures for any pesticide incident involving fish or wildlife; and,
- Laboratory reports from DFG or the Department of Food and Agriculture.

No central database exists to track these incidents, or to query their human or environmental impacts. The data are maintained separately, and no effort is made to compare or to reconcile the different datasets. Hence, current data collection and management make trend analysis difficult. In most cases, the pesticide cannot be determined, or cannot be linked to a source (a known use or user) for a variety of reasons: obtaining evidence (tissue samples or environmental samples) for laboratory analysis is extremely difficult; the results of the analyses are inconclusive; and the location where contamination and subsequent fish or bird exposure occurred cannot be determined due to the mobility of the animals. It is also unknown whether the fish or bird kills tracked are a reasonable approximation of actual incidents. These incidents can occur without the county agricultural commissioners or other agencies being notified, as there is no incentive for a property operator or a pesticide applicator to report these incidents.

Type III

Pesticide Detections in Surface Water and the Percent that Exceeds Water Quality Standards

This indicator will present the frequency of pesticide detections in surface water, and the concentrations compared against applicable water quality standards. The Department of Pesticide Regulation (DPR) maintains a Surface Water Database that includes results from pesticide monitoring studies and toxicity testing. However, the monitoring that generated the data was not designed for long-term trend analysis. Protocols for long-term trend studies have not yet been adopted, and DPR is investigating the feasibility of a monitoring network.

As of July 15, 2000, the database contained the results of 30 studies conducted by federal, state, and local agencies, private industry, and an environmental group. The purpose of these studies was to characterize concentrations of pesticides at a particular site over a specific time period, not to characterize long-term trends. Sites were typically selected based on the likelihood that the water body had a high concentration of pesticides. The database catalogues the results from more than 4,600 samples taken in 16 counties from January 1991 through March 2000. Toxicity tests were performed on samples taken in 15 of the 30 studies. Each record in the database is the result of one analysis for a pesticide active ingredient or breakdown product, or an endpoint measurement taken during a toxicity test. The database contains approximately 92,000 analytical records and 3,300 toxicity test measurements.

Data on pesticide concentrations in surface waters would be compared against applicable water quality standards. At present, standards that protect public health and aquatic habitats have not been developed for all pesticides. Where standards do exist, they may change over time, or multiple levels for the same pesticide may exist, causing confusion as to which level is most appropriate. There has been increased concern about the effects of surface water contaminants on ecosystem health. Currently, Total Maximum Daily Loads (TMDLs) are being developed by Regional Water Quality Control Boards to address inputs of contaminants in aquatic environments. After TMDLs are developed, waterbody-specific targets for contaminants, including pesticides, will be adopted.

Reference:
Department of Pesticide Regulation, Surface Water Database. Posted at: www.cdpr.ca.gov/docs/surfwatr/surfdata.htm

For more information, contact:
Marshall Lee
Department of Pesticide Regulation
Environmental Monitoring Branch
P.O. Box 4015
Sacramento, California 95812
(916) 324-4269
mlee@cdpr.ca.gov

Number of Detections of Pesticides Identified as Toxic Air Contaminants and the Percent that Exceeds Numerical Health Standards Each Year

Type III

This indicator will reflect the frequency of detection of pesticides designated as toxic air contaminants (TACs); furthermore, measured concentrations will be compared against numeric health standards. These standards have not yet been determined, but will be set at a level intended to protect against potential adverse impacts on human health.

Thirty-seven pesticides have been designated as TACs in Title 3, California Code of Regulations, Section 6860 (both Department of Pesticide Regulation [DPR]-designated pesticides and federal hazardous air pollutants). California has established most of the scientific, regulatory, and administrative infrastructure to implement this indicator. State law mandates the key elements of the TAC Program. Sampling and laboratory methods have been validated for most TACs. DPR and the Air Resources Board (ARB) have established procedures and resources to monitor for pesticides, determine exposures, and estimate risk. However, there are significant shortcomings to using the existing program as an environmental indicator.

PESTICIDES

This environmental indicator requires a network of stations that monitors the air on a regular basis. California has no such network for pesticides. The TAC Program is a collection of individual projects. At the request of DPR, ARB monitors for pesticides that are candidate TACs to gather information to assist DPR in the identification of a pesticide as a TAC. Little monitoring has been conducted for the pesticides already designated as TACs, particularly the 34 federal hazardous air pollutants that were designated administratively. Currently, monitoring occurs in areas where the most pesticides are applied, normally rural agricultural areas. Monitoring normally occurs for a few weeks during a single season of high use. The area and season of highest use vary among pesticides. Monitoring collects pesticides that are in the air as a result of application, drift, and post-application volatilization and offsite movement. However, the monitoring methods are optimized to collect gas-phase pesticides, and drift may not be collected efficiently. Additionally, the drift that is detected cannot be segregated from the gas-phase pesticides.

The ARB monitoring network for TACs currently focuses on non-pesticides in urban areas. DPR would need to establish a monitoring network for pesticides to implement this environmental indicator.

Reference:

Air Resources Board, Pesticide Air Monitoring Studies for the Toxic Air Contaminant Program. Posted at: www.cdpr.ca.gov/docs/empm/pubs/tac/tacstdys.htm

For more information, contact:

Randy Segawa
Environmental Monitoring Branch
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, California 95812
(916) 324-4137
rsegawa@cdpr.ca.gov